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DENSITY OF RADIO-LEAD FROM PURE NORWEGIAN CLEVEITE

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Received by the Academy, August 4, 1916

Through the kindness of Prof. Ellen Gleditsch of the University of Kristiania we have been so fortunate as to receive a specimen of lead sulphide from carefully selected Norwegian cleveite. According to Dr. Gleditsch, "The Norwegian uraninites are very old and very unaltered. They are found in well developed crystals and occur in connection with the pegmatite dykes in southeastern Norway." The sample in question occurred in cubic crystals near Langesund.

As Hönigschmid has already pointed out[1] the properties of radio-lead (this name being used provisionally to designate lead produced by radioactive transformations) obtained from pure minerals of this sort are far more interesting and significant than those of lead obtained from ordinary uranium ores, which doubtless contain some admixture of ordinary lead. Hönigschmidt has shown that the lead from pure cleveite has an atomic weight as low as 206.06, and our own experience with the sample referred to above essentially confirms this result, as will be shown in another communication. So far as we know, however, the density of lead of this kind has not yet been determined, and accordingly the present paper recounts such a determination, which forms an interesting sequel to the recently published results on the density of Australian radio-lead.[2]

The purification of the sulphide, which doubtless contained traces of sulphides of other metals was carried out as follows: The specimen was dissolved in nitric acid and crystallized three times with centrifuging as nitrate,—a process which Baxter's experience has shown to be an excellent one for the purification of lead from other metals.[3] From this purified nitrate the chloride was precipitated by pure hydrochloric acid, and this salt was crystallized three times. The final crystals, after draining on the centrifuge, were stored in a vacuum desiccator over caustic soda. The chloride thus prepared was used for the determination of the atomic weight, the density being determined in the material saved from the filtrates from that determination. These filtrates contained excess of silver, therefore enough hydrochloric acid was added to bring the concentration of the dissolved chloride ion to 0.01 normal, because at this concentration silver chloride is most nearly insoluble.[4] When the precipitated silver chloride had settled and had been removed by filtration through a Gooch-Munroe crucible with platinum mat, the resulting solution was concentrated and crystallized once more as nitrate. The pure crystals were electrolyzed, and the pure radio-lead treated exactly as in the case of the other samples previously described.[5]

As the amount of substance at hand was very small, the work could not be done quite so accurately as before. The density determinations were made in the same pycnometer as before, by the second method described on page 223 of our previous publication, the volume of the pycnometer having been redetermined because its tip had been broken in the meantime. Four identical determinations gave 5.7200 as the weight of water in the pycnometer at 19.94°, weighed in air. Therefore, the volume of the pycnometer was 5.7361 cm.

TABLE 1

DENSITY OF LEAD FROM CLEVEITE

OBSERVED WEIGHT	WEIGHT IN VAC. (W)	OBSERVED WEIGHT WATER NOT DISPLACED	CORRESPONDING VOLUME	VOLUME OF PYCNOMETER	VOLUME (V) OF WATER DISPLACED	DENSITY (W/V)
4.4252	4.4250	5.3287	5.3437	5.7361	0.3924	11.277
4.4252	4.4250	5.3286	5.3436	5.7361	0.3925	11.274
4.4252	4.4250	5.3285	5.3435	5.7361	0.3926	11.271
4.4252	4.4250	5.3285	5.3435	5.7361	0.3926	11.271
					Average	11.273

The density of this sample, presumably a nearly pure isotope, is thus 11.273, distinctly less than 11.289, the density of the Australian radio-lead, and still less than the density 11.337 found for ordinary lead. The decrease is almost exactly proportional to the decrease of the atomic weight in these samples; for the atomic weight of the Australian lead was about 206.35, and that of this sample 206.085. Thus the atomic volume of the isotope, 18.281 (equal to 206.08/11.273), is almost identical with that of pure lead, as indicated by our previous experiments. Thus 18.281 is essentially equal, within the limit of error of experiment, to the value 18.277, found for ordinary lead, and to the value 18.279, found for Australian radio-lead. It is interesting to note that Australian radio-lead would be essentially duplicated as to these properties by a mixture consisting of three parts of pure isotope to one of ordinary lead.

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[1] Hönigschmid, *Sitzungsber. Wiener Akad.*, **123**, II a, 20 (1914).

[2] Richards and Wadsworth, *J. Amer. Chem. Soc.*, **38**. 221 (1916).

[3] Baxter and Grover, *J. Amer. Chem. Soc.*, **37**, 5 (1915).

[4] Forbes, *J. Amer. Chem. Soc.*, **33**, 1937 (1911).

[5] Richards and Wadsworth, *loc. cit.*, p. 224.